NOTES ON THE FEEDING HABITS OF CARRION BEETLES

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The general opinion among entomologists seems to be that the beetles of the two genera *Silpha* and *Necrophorus* are beneficial scavengers, feeding entirely upon decaying material. In contrast to this opinion a few observers have noticed the beetles feeding not upon the decaying material itself, but upon the fly larvæ infesting it. Charles U. Clark in THE JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, June, 1895, p. 61, and Wm. T. Davis in the same Journal, June, 1915, p. 150, both reported this to be the case, but failed to give any experimental data. Some such data obtained at the American Museum of Natural History's Station for the Study of Insects, located at Tuxedo, N. Y., is of interest in this connection.

On July 28, 1926, while watching and collecting carrion beetles on the well-rotted carcass of a woodchuck, I noticed that several of the beetles were carrying fly larvæ in their jaws as they crawled around the dead animal. Closer observation showed that the beetles were coming out through holes in the woodchuck's skin, each with a wriggling maggot between its jaws, and were crawling onto the top of the carcass or out among the nearby leaves where they stopped to devour their prey. This unusual behavior was repeated time after time during the next half-hour that I watched. Four species were seen eating maggots: *Necrophorus, orbicollis, N. tomentosus, Silpha americana,* and *S. novaboracensis.*

Three live specimens of each species were placed in glass-covered plaster boxes, the *Necrophori* in one box and the *Silphae* in another box. Later, in the evening of the same day, about twenty live maggots were turned loose in each box. By the morning of the next day (July 29) every one of the maggots had been eaten; and, in addition, the smallest *Necrophorus tomentosus* had been devoured and the large *N. orbicollis* were in the act of dismembering another of their smaller relatives.

During the day several more maggots were dropped into the boxes and I watched the process of eating through the glass cover. Almost as soon as the food was in the boxes the beetles began a slight waving of the antennae and a rapid movement of the palpi. When, after some moments of crawling around, apparently in search of the maggots, a beetle found one of the wriggling larvæ it seized it fiercely and went into some corner to eat. When the maggot was held by either the head or the tail it was eaten in much the same way as a leaf of lettuce is eaten by a rabbit, the jaws pulling the food in like a machine. Sometimes when the maggot had been seized in the middle it was bitten in half, and the part remaining in the beetle's jaws was eaten as before. The small *Silpha novaboracensis* often seemed to eat only the soft inner parts, leaving the tough outer skin empty and untouched. This was especially true when a large maggot was taken up.

The fact that carrion beetles ate the fly larvæ occurring in the decaying material was no longer doubtful, but this problem arose: Did the beetles actually prefer the maggots to the carrion itself as food? In an attempt to answer this problem eighteen of the beetles, about equally divided between *Silpha* and *Necrophorus,* were placed in a large plaster box and left without any food for three hours. At the end of that time a piece of carrion from which the maggots had been removed was placed at one end of the cage, and a small developer vial two-thirds full of tightly packed maggots was emptied at the other end. Some of the beetles of each genus went immediately to the pile of maggots and began eating. Several went to the carrion, nibbled at it a little bit, but left it almost at once without really eating and went to the pile of maggots. At the end of a very few moments every one of the beetles was eating the maggots; not a one was paying any attention to the carrion.

Another somewhat similar experiment was performed with a mixed group of about twenty-five beetles of the four species mentioned above. They were left to starve from 5:00 P. M. one evening until 11:00 A. M. the next morning. A piece of maggotless carrion was then put in the cage. The beetles walked over it rather disinterestedly, some of them giving it one or two half-hearted bites. Four hours later, at 3:00 P. M., several maggots were quietly dropped into the cage. There was an almost instant response of increased activity among the beetles; one *Necrophorus orbicollis* and two *Silpha americana* picked up maggots at once. At the end of ten minutes seven *S. americana,* four *S. novaboracensis,* two *N. orbicollis,* and two *N. tomentosus* were eating the wriggling larvæ; and before long all except a few very sluggish beetles had prey in their jaws. Although there was an abundance of food two beetles would occasionally fight over the same maggot, one of them at each end, pulling until one or the other gave up. This experiment seems to indicate a decided preference for maggots, since at the end of an eighteen-hour starvation period the beetles paid little or no attention to carrion, but were nearly unanimous in their choice of the fly larvæ.

In another case a dead, white-footed mouse in which there were no maggots was placed in the cage with half-starved beetles. They came to the carcass a few at a time and began eating around the eyes and mouth. One *N. orbicollis* started to eat rather ravenously at one of the mouse's eyes; but when a maggot was held in front of the beetle's head with a pair of forceps it was seized and immediately devoured. This was repeated with the same result with two other *Necrophori* which were eating around in the mouth. All the beetles, representing the same four species used before, began, with one exception, to eat maggots as soon as the latter were put in the cage. The one exception was a slow moving *Silpha americana* which kept crawling over the mouse's head, taking occasional bites in the mouth of the dead animal.

That these beetles eat carrion can not be denied, for they can easily be seen doing it. One very clear case was observed. The carrion was the comparatively fresh carcass of a large rat. There was not a very strong odor of putrefaction as yet, and although the various species of carrion flies had laid their eggs, there were not yet any maggots except a few very tiny ones which had probably been laid alive. At this stage, before the appearance of any sizable fly larvæ, thirteen specimens of *Necrophorus,* both *orbicollis and tomentosus,* arrived on the scene during a period of five hours. Most of them merely wandered back and forth over the dead body or else crawled and burrowed beneath it.

However, one began eating at the mouth, two at the eyes, and two on the stomach. The first three of these had immediate access to soft flesh, but the two which were eating on the stomach of the rat were confronted with a layer of fur and tough skin. They overcame their difficulty by cutting slits about three-eighths of an inch long through the skin by means of their sharp, heavy jaws; and they were then able to tear off and eat small pieces of the flesh beneath. One striking thing was noticed in this case of the rat, in the case of the white-footed mouse mentioned above, and in one other case where the beetles were seen to eat maggotless carrion with more or less relish. It is that in all three cases the carrion had not yet advanced very far in the process of decay. The flesh was still very similar to that of living animals, and in a strict sense the beetles were not eating putrefying material. That fact makes even more plausible the theory that the beetles prefer maggots as food whenever they are able to choose between the fly larvæ and carrion. This theory is also supported by the fact that captive beetles having only maggotless carrion for food rarely lived over four days, while captive beetles having either maggots alone or carrion which contained maggots lived as long as ten and eleven days. The beetles seem to be able to subsist for only a short time on carrion alone, and do not eat it voluntarily except when it is comparatively fresh.

A device which was made rather crudely and consequently was not very reliable was used to test the preference of the beetles. It consisted of a box in the form of an isosceles triangle, having at each end of the base and at the apex of the triangle a smaller box. Each of these smaller boxes communicated with the main box through a little opening in the side of the latter, and had a screened opening on the side away from the main box. Air could thus pass freely through the whole thing. Different types of food were placed in the two boxes which were at one end of the device and the beetles were placed in the box at the other end. The device was then put in a current of air so that the air passed from the food boxes through the main box into the box where the beetles were, and the beetles tended to follow up the current of air into one food box or the other, supposedly showing a preference for the one in which it stopped.

As stated above, the device was probably not very reliable. The beetles were released in their box one after another at intervals of a few seconds until a group of ten had been released. Only in a very few instances did all ten beetles reach the two food boxes, some of them were almost sure to stop in the main box. Two fairly typical results are as follows:

1. Given the choice between carrion alone and carrion containing maggots, three beetles went to the former and five went to the latter.
2. Given the choice between carrion alone and maggots alone, three beetles went to the former and six went to the latter.

In both instances a slight, though not extreme, preference was shown for the maggots, and this slight preference was fairly constant in all trials. This piece of apparatus doubtless has much greater possibilities than are shown by the little use made of it.

The question of just what it is that carrion beetles do eat and prefer to eat may be impossible to decide, but the data given above certainly seem to indicate that the four species, *Necrophorus orbicollis, N. tomentosus, Silpha americana,* and *S. novaboracensis,* prefer to eat fly larvæ.